COOL SHOES: LINEAR

Adapted from CPM Educational Program's project "Bee Bopper Shoe Store"

LESSON PLAN

The extent to which a teacher uses this lesson depends on the level of the course. A pre-algebra student may only be capable of plotting points, recognizing the correlation, and estimating a line of best fit. Beginning or advanced algebra students will be able to find the slope, y-intercept, and write the equations. All students should be able to solve the equations for one variable given a value for the other. Therefore, for a pre-algebra class, the teacher may give the students the equations, discuss the values of slope and y-intercept, and then have the students plug in their numbers.

Begin the class by having students come to the board, one boy and one girl at a time, and write their height (in inches) and their shoe size in the charts provided. While the others are waiting their turn, they should be copying the information into their own charts.

Next, have the students plot the points. They must first establish the scale for each axis. The height is the domain. The students should recognize that if they simply start at zero and count up by ones to 70, they will run out of room on their papers. Discuss how they really don't need any numbers less than 58, so they can establish a broken scale on the axis. The shoe size is the range, so we label that axis from 0 to 13, in increments of one-half. Then have the students plot the boys' data using a certain color or symbol (+). Then have them plot the girls' data using a different color or symbol (*). Once the data is plotted, prompt the students to articulate the relationship between the height of a person and their shoe size. Is there a correlation?

Concepts
Plotting points, lines of best fit, writing equations.
8.SP.A.1, 2, 3
HSS-ID.C7

Time: 1-2 hours.

Materials
Student handout

Preparation
Students will need a means by which to measure their height. Establish a vertical "height line" on the board, so that students simply stand with their backs to it and have a classmate read the height. Also, have the boys and girls charts as well as the one quadrant coordinate plane on the board when class begins.

Once the students agree that taller people generally have larger shoe sizes, have them draw an approximate line of best fit for each gender. Students should then find the rate of change of shoe size to height (slope). Help them articulate their answers. For instance, if a student calculates the change in *y* of 3 shoe sizes and a change in *x* of 6 inches, they should say that there is change of 3 sizes for every 6 inches, or a half shoe size per inch.

Have the students calculate the y-intercept of the line. They should understand that this would be the shoe size for a theoretical person of zero inches tall. The answer will not make sense according to where their projected line intersects the y-axis. In other words, their line looks like it has a y-intercept of 1, but their calculated intercept may come out to be -24. This contradiction is due to the broken scale along the x-axis. Have students mentally stretch this axis until it is continuous, and they will more easily see how the line "gets down that far."

Once the students have determined their equations, have them choose values for *x* and *y* (height and shoe size) that do not appear on the charts. The students can then substitute the values into their equations and check that the solution appears on the line of best fit. For instance, assume that no girl in the class is exactly 68 inches tall. Have the students use their equation of the line of best fit for the girls data to find the appropriate shoe size for a 68 inch tall girl. This solution should lie on the line. Students should repeat this process for a missing shoe size, as well as. This allows them to practice solving for *y* given *x*; and also the more difficult task of solving for *x*, given *y*.

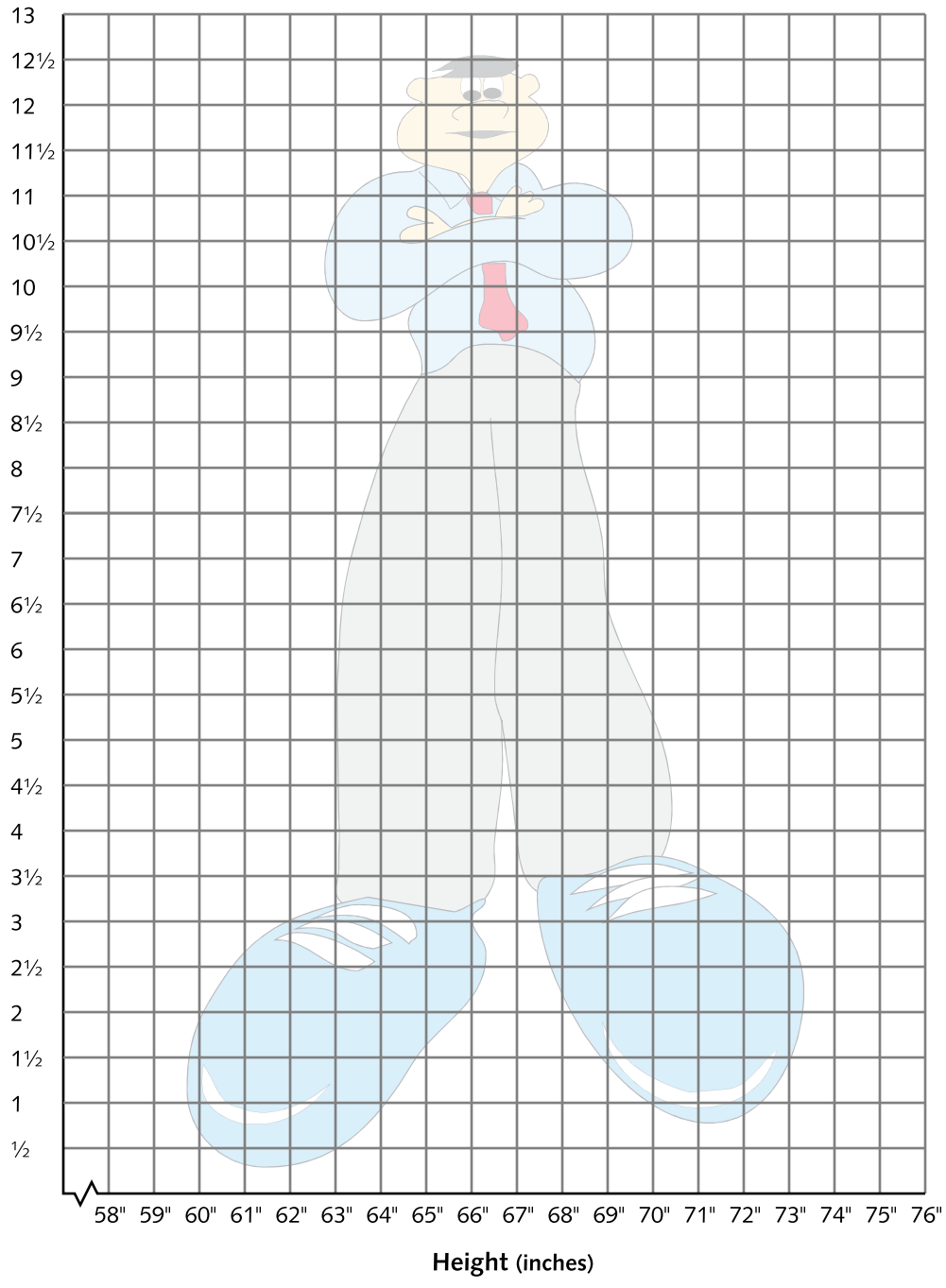
STUDENT HANDOUT

COOL SHOES: LINEAR

You own and operate NewCoolShoes.com, an online shoe store. Many people want to order shoes for friends and relatives, but do not know their shoe size. Since it is easier to estimate a person's height than shoe size, you want the customer to be able to enter a person's height and calculate the appropriate shoe size (approximate). You must have either a graph or equation in order to do this. So, your task here is to create both, using sample data from your class.

BOYS

Height (inches)	Shoe Size
75	10.5
70	12
72	13
70	10
74	14
72	11.5
70	10.5
74	12
70	10.5
76	13
68	13
76	12.5
65	7
66	8
67	8.5
75	14
69	9.5
72	9
71	10
69	10
73	11
69	12
72	10
73	11
69	10



GIRLS

Height (inches)	Shoe Size
59	5
60	7.5
61	7
66	9
63	7
66	7.5
63	6.5
37	6.5
32	7.5
32	6.5
38	11
39	10.5
72	11
68	8.5
63	8.5
68	9.5
67	8.5
66	9.5
67	7
69	9
60	7.5
66	7.5
65	7
64	8.5
68	9

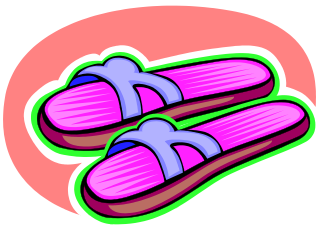
COOL SHOES: LINEAR (CONTINUED)

1. Fill the charts with data from your class. Record each person's height and shoe size.
2. Plot data points from the charts. Use one color or symbol (+) for boys and a different one for girls (*).
3. Do you notice any relationship between people's height and shoe size? What kind of correlation is it?

4. Draw an approximate line of best fit for each set of data (one for boys, one for girls).
5. For each line, calculate the rate of change (slope).

   BOYS: There is a change of _____ sizes for every _____ inches of height, or _____ sizes per every one inch.

   GIRLS: There is a change of _____ sizes for every _____ inches of height, or _____ sizes per every one inch.



6. a) Calculate the y-intercept of each line. **BOYS:** _____ **GIRLS:** _____

   b) What do these intercepts imply? Do they match your graph?

7. Write the equations of each line.

   BOYS: _____ **GIRLS:** _____

8. For each set of data, find a **height** that does NOT appear in the chart. For instance, if no girl in the class is exactly 68" tall, then choose 68 inches for the girls. Use your equation and your chosen value for height to find the corresponding shoe size at that height. Do your solutions match the graphs?

   BOYS: Height = _____ **GIRLS:** Height = _____
   Shoe Size = _____ Shoe Size = _____

9. For each set of data, find a **shoe size** that does NOT appear in the chart. For instance, if no boy in the class has a shoe size of 13.5, then choose 13.5 for the boys. Use your equation and your chosen value for shoe size to find the corresponding height. Do your solutions match the graphs?

   BOYS: Height = _____ **GIRLS:** Height = _____
   Shoe Size = _____ Shoe Size = _____